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Smart Vapour Barriers

From the Editor . . .

Human activity always seems to be influenced by fads. Just as kids, in an effort to be rebellious in clothing, end up wearing a uniform, adults too fall for fads. The home building industry is not immune to this any more than the investment community with its hot picks of the financial season. There are fads in home designs, construction practices and materials usage. The same goes for mistakes and problem diagnosis.

I am increasingly concerned about a real problem that has recently emerged; a problem with serious consequences to people's health, but one that may have got lost in a lot of excessive hype. The problem I am referring to is mould. There is no doubt that the number of occurrences of serious mould infestations has increased. This may be caused by the way we build and manage our buildings today, which is significantly different from in the past.

I am also concerned about the way the problem is being dealt with. There are ever more references to the "mould industry." People are searching for "standards" and soon there will be pressure for licensing. At the same time, there are reports of questionable tests being done to prove the presence or absence of moulds, depending on whose interests are being served. And, of course, armies of lawyers are studying about mould to prepare for future litigation. Soon there will be pressure for someone (governments?) to do something about it.

Last year draft legislation was proposed in the US Congress. Fortunately, it didn't get too far because it was totally unworkable. Among other requirements, the legislation would have required mandatory annual inspections for all rental premises and any indication of mould would have required action, despite the fact that there is no simple and meaningful way to test for mould. The way the draft was written, the blue cheese in the kitchen or a teen's unwashed clothes lying around for a few days would probably have triggered a requirement for action.

I have heard reports of insurance companies hiring incompetent personnel to do the least possible mould testing in the least likely mould locations in an insured's property so there would be little likelihood that any mould would be discovered. Others have conditioned buildings to encourage mould growth so test results would show high mould levels to justify expensive remedial work. And there are also the mould busters who will sell magic paints or cleaning services supposed to cure all mould problems.

Unfortunately, all of these ignore the fundamental issues which create the conditions that allow mould to flourish. Too many actions deal with the symptoms and not the underlying causes.

Dealing with mould is not going be easy. A few tests will not indicate much else than the presence of certain kinds of moulds – and probably miss many others. In most cases, simply cleaning up the mould and repainting is not going to solve the problem. Mould is a fundamental element that Mother Nature has created to recycle organic matter. It is present everywhere, and will never be eliminated. We must learn to live with it, and keep it in check at acceptable and safe low levels within our buildings.

Richard Kadulski,
Editor

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Smart Vapour Barriers

The smart vapour retarder reduces the risk of moisture damage in a building envelope by increasing the construction's tolerance to load moisture. It would not work well in buildings with high indoor humidities such as swimming pools and spas.

In climates dominated by heating needs, insulated building assemblies need protection against moisture diffusion into the construction assembly in order to keep vapour from areas where it could condense. Vapour barriers are used to protect the wooden parts in the roof or wall from moisture damage by minimizing the diffusion of moisture in areas where it can create problems. Water vapour always tries to move from areas of high vapour pressure to areas of lower vapour pressure – usually from inside to outside.

But it is important to remember that there is no such thing as a perfect vapour barrier. Any moisture that penetrates the construction assembly will condense on cold surfaces and accumulate in the construction materials, especially those capable of absorbing moisture. When enough moisture has accumulated, critical moisture content conditions develop and moisture dependent damage such as mould growth and rot takes place. The diffusion resistance of the vapour barrier will determine how much moisture gets inside the construction. Some moisture will be stored in the wood, which has a reasonably large capacity for it.

Since the actual conditions buildings operate under are more variable and less extreme than the design those to which we design, we need to address the full range of conditions. During the heating season, the relative humidity inside buildings is generally low (which is why people use humidifiers). In the summer, the relative humidity is much higher both inside and outside buildings, and construction materials can absorb considerable quantities of moisture. If more moisture can get into the construction assembly than can leave, moisture build-up occurs.

A vapour retarder not only retards moisture penetration, but also the drying potential when the season changes. This can lead to moisture accumulation that may not be able to dry out, especially if the exterior has low permeability. In building detailing, the drying potential should always be greater than the wetting potential. To put it in another way, the amount of moisture that can get into a construction assembly should always be less than the amount of moisture that can leave it.

The most commonly used vapour barriers are polyethylene films, which have a consistent, very high vapour diffusion resistance throughout the whole year. While these films resist vapour movement into the wall assembly, they also reduce the potential for summertime drying.

In regions with a cold climate, the vapour pressure difference between inside and outside a building can be considerable, and the conditions are fairly consistent, so an effective vapour barrier like polyethylene is quite appropriate. In regions with milder climates that have less severe winters and longer warm periods, the moisture diffusion forces can be less dramatic and the pressure differentials are reversible for longer periods of time.

In the summertime, when the sun is stronger, exterior surfaces are warmed, and at times are warmer than the interior thus creating a reverse vapour drive into the interior. Thus the moisture in the assembly, in the form of water vapour, can move in both directions: to the outside and to the inside.

Because of the need to deal with the variable conditions, some designers are calling for "breathable" walls. Airtight drywall construction has a slightly more permeable vapour retarder which allows some moisture diffusion through it. This allows some drying by vapour diffusion to take

Vapour barrier or vapour diffusion retarder?

The Building Code refers to "vapour barriers" as the elements that must resist vapour diffusion. The use of the term "barrier" implies it must be perfect. Technically, this is not the case. A vapour barrier can be a membrane, material, or coating that slows the *diffusion* of water vapour. Polyethylene, aluminum foil and low permeance paint can be used as vapour barriers. The more correct terminology would be "*vapour diffusion retarder*."

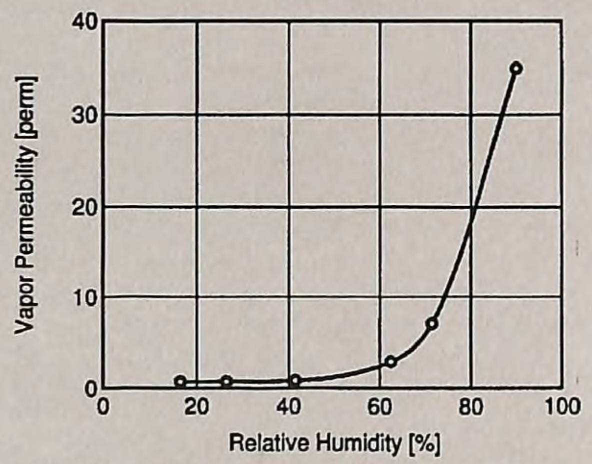
Much of the confusion stems from the fact that polyethylene sheets have been used to do double duty, as both a vapour diffusion retarder and as an air barrier. Yet both of these are different, distinct functions and can be done by different materials. The Building Code recognizes the distinction, but the two terms are used interchangeably.

place in either direction, even though the vapour barrier is still in place, and the construction is still airtight.

Ideally, the design and building materials would have properties that could react to varying conditions. A product that has been on the European market since 1997 seems to provide a solution to the "reversible" vapour retarder. Think of it as a smart vapour barrier.

Isover Vario KM climate membrane was introduced in Germany in January 1997 and has been sold with growing success even though it is two to four times more expensive than competitive materials on the market. The membrane looks like polyethylene, but is actually nylon-based. Nylon is a tough material with high tensile strength, so a 2-mil sheet has equivalent properties to a 6-mil polyethylene sheet. It is also impermeable to organic pollutants and gases.

Smart Vapor Retarder



Variation of vapour permeability of the smart retarder with the relative humidity in its immediate vicinity.

Isover Vario KM is a product of Saint-Gobain Isover SA. At this time, the material is not available in North America., but plans are underway for its introduction soon. Information on the product can be found on their European Web site: *www.isover.de* which is mostly in German or French.

It behaves somewhat like a sensitive skin, reacting to the relative humidity by altering its physical structure.

Field tests have shown that this smart retarder effectively reduces the risk of moisture damage in the building envelope by increasing the construction's tolerance to load moisture. It is appropriate in heating and mixed climates, but is not suited for cooling climates with high outdoor humidities. It would also not work well in buildings with exceptionally high indoor humidity levels, such as swimming pools and spas. In rooms with short peaks of high humidity, such as bathrooms and kitchens, the smart retarder's performance would not be affected because of the buffering action of interior finishes.

Isover Vario KM has a high resistance to water vapour during wintertime, when relative humidities are low, and it is needed to protect against vapour penetration from the interior. However, when conditions change and the relative humidity increases above 70%, the pores in the material expand and its permeance increases, allowing water vapour to pass across it. Thus, its lower resistance value supports the drying process. ☼

Field Tests of Unvented Vaulted Ceilings

In Europe, vaulted ceilings are standard. The typical roof construction is rafters filled with insulation, often with a vented space above the insulation. The roofing is tiles, shingles or metal. Moisture can penetrate into the roof assembly from the outside through imperfections in the roof, outward air leakage from the interior, and construction moisture in the framing materials.

An experiment done at Germany's Fraunhofer Institute (the counterpart to Canada's National Research Council) tested the smart vapour barrier for unvented roof assemblies. They looked at a worst case example, with a sheet metal roof facing north and south. The metal roofing was applied over wood sheathing, the joist cavity was fully insulated with mineral wool insulation, and three different vapour barriers were used on the interior: a kraft paper, polyethylene, and the smart vapour retarder.

Indoor conditions varied between 20°C (68°F) and 40% relative humidity in winter, to 23°C (73°F) and 60% RH in summer. The lumber components started at a moisture content of about 20%.

The moisture content in the south side roof fell quickly within a few months because of solar radiation hitting the roof. A small amount of condensation was noticed on the outside face of the poly vapour barrier. Some mould was observed on the outside face of the kraft paper vapour barrier.

On the north-facing roof, no condensation was noticed during the first year because the roof temperatures were much lower. However, the amount of time it took to dry to the critical moisture content of less than 20% was much longer – 3 months with the smart vapour barrier, and 4 months with the other vapour barriers.

With a smart retarder, the moisture content in the lumber dropped below critical levels. Where poly or kraft was used, the moisture content of the lumber components went up to 25% the second year because of the redistribution of moisture within the wood. When the tests were rerun with interior drywall finish, it was noted that the humidity on the cold side of the vapour barrier was high, and increased in the spring when the warmer roof surface temperatures reversed the vapour drive inward. Only the smart vapour barrier allowed the moisture to dry out inward, thus protecting the construction assembly.

The study concluded that a smart vapour barrier reduces the moisture damage in the building envelope by increasing the moisture tolerance of the assembly. This is a valid observation for heating and mixed climates. Because of the increase in permeability above 70% relative humidity, a smart retarder is not appropriate for use in areas with high humidities, such as swimming pools, spas and solariums. ☼

More Moisture Load Tolerance of Construction Assemblies Through the Application of a Smart Vapour Retarder, by Dr. Hartwig M. Kuenzel, Fraunhofer Institute for Building Physics. Paper at the ASHRAE Thermal Envelopes VII Conference, Clearwater Beach, FL 1998.

Environmentally Safe Wood Treatment

Recent widely publicized building envelope failures in the coastal region of BC have highlighted the problems of excessive wetting of structural wood products. Moisture and insect induced structural deterioration are not exclusive to coastal BC – the concerns are worldwide.

Designers and builders are looking increasingly at alternative products that will be durable and less susceptible to deterioration. That is why there is more use of preservative treated wood products, not just in ground-contact applications, but also for above ground use. At the same time, consumers are increasingly hesitant about reliance on toxic preservative treatments. There is a real wish to use environmentally friendly preservative products.

In order to continue to use lumber products comfortably, environmentally safe treatment products are needed. That is why the design community has embraced borate preservatives. However, because of their high water solubility, most borate treatments can only be used in limited applications. In addition, engineered wood products like OSB are difficult to treat.

A recently patented process that is gaining attention was developed in Vancouver by Dr. Marek Gniatowski and Dr. Robert Knudson uses zinc borate treatment. Zinc borate is considered to be an environmentally benign wood treatment and is well suited for use in engineered wood products.

Although zinc borate is water soluble, it is much less so than water applied borate treatments. Zinc borate is applied during the product's manufacture, thus ensuring complete penetration through the product, and is much more resistant to leeching than other borate treatments.

Louisiana-Pacific Corporation is using this process for OSB panels, which are marketed under the ***SmartGuard*** label. ***SmartGuard*** is not appropriate for use with ground contact or where the product will be wet constantly. Using it in areas that might get wet only occasionally, such as rain exposure during construction or occasional water leakage, should not affect the treatment.

SmartGuard's initial marketing push has been in the southern US, where termites are a major problem. However, it provides equivalent protection against moisture induced fungal deterioration. ☼

Top 10 Green Building Products

The publisher of the *GreenSpec Directory* and *Environmental Building News* announced its pick of the top-ten top ten new green building products for 2002 at the U.S. Green Building Council's International Green Building Conference in Austin, Texas. The list recognizes the most exciting products added to the Greenspec directory Directory during the past year (though some products may have been on the market longerr.).

GreenSpec is a leading green building products directory with more than 1,650 products listed and selected by editors of Environmental Building News (EBN) based on criteria developed over the past seven years. Manufacturers do not pay to be listed in GreenSpec.

The ten products chosen represent a wide range of materials, products, and equipment that can help to reduce the environmental impacts of a building. Seven are have directly applicable to residential applications, and three have are for commercial applications.

L.I.F.T. Foundation System

This is a unique, engineered cast-in-place foundation system that can be installed with almost no excavation. Sections of foundation wall are poured above ground and "pinned" into the ground using heavy-duty steel pins that extend deep enough to support the structure and prevent uplift. It, reduces reducing site development costs and allows allowing less disruptive site development. This technology has been used for about five years in supporting boardwalks in ecologically fragile locations, such as wetlands, where excavation would cause significant damage. The system is currently being marketed only in US Pacific NorthWestNorthwest.

Pin Foundation Inc., Gig Harbour WA.
Tel.: 253-858-8809 *www.pinfoundations.com*

FSC-Certified Tuff-Strand OSB

The Roy O. Martin Lumber Company is the first OSB product to be certified according to standards developed by the Forest Stewardship Council (FSC). This is a Louisiana-based company which that owns and manages 500,000 acres of timberland in the southern US.

Tel.: 800-299-5174 Fax: 318-445-1973
www.martco.com

WoodStalk FiberboardFibreboard and Underlayment

This is a fiberboardfibreboard product made from wheat straw. It is available in various thicknesses for use in cabinets, shelving, furniture, and underlayment. Not only is the product made from a waste agricultural material (straw), but also no formaldehyde is not used in its manufacture. It is available in many major building materials' suppliers including Home Depot.

Dow BioProducts, Ltd
11 Woodstalk Way
Elie, Manitoba, R0H 0H0
Tel. : 979-238-5329
www.dow-bioproducts.com

Johns Manville FiberglassFibreglass Insulation

Johns Manville modified their manufacturing process for fiberglassfibreglass insulation in early 2002 to eliminate the industry-standard phenol-formaldehyde binder used to hold the glass fibres together. The reformulated fiberglassfibreglass uses an acrylic binder. Johns Manville also offers the highest guaranteed post-consumer recycled content of any fiberglassfibreglass insulation (18%), with a guaranteed total recycled content of 25%.

Kalwall R-20 with Nanogel

Kalwall manufactures translucent glazing that is widely used in commercial buildings for daylighting. Until recently, their best product had R-10 insulation value with a visible light transmittance of only 9%. Their newly introduced Kalwall R-20 is a 70 mm (2 ¾") thick glazing system that provides a higher insulation value and also transmits up to 20% of visible light. This is achieved by filling the glazing unit with a granular silica aerogel.

Kalwall Corporation
Manchester, NH
Tel.: 800-258-0777 Fax: 603-627-7905
www.kalwall.com

Pure Performance Zero-VOC Paint

PPG Architectural Finishes has the latest zero-VOC product to enter the market. While most low-VOC paints today use acrylic or vinyl acetate resins, Pure Performance uses a newer vinyl acetate ethylene resin. It is the first paint to be certified under a new Green Seal standard for paints.

PPG Architectural Finishes, Inc.
www.ppgaf.com

WatterSaver Heat Pump Water Heater

WatterSaver from ECR International, Inc. is the first heat-pump water heater that is designed as a drop-in replacement for a standard electric water heater. The 50-gallon unit extracts heat from the indoor air to heat water using about half the energy of an electric-resistance water heater. During operation, the WattSaver consumes about 500 watts of electricity and produces 3,5000 Btu per hour of cooling, which in a warm climate is free air conditioning. Compared with earlier heat-pump water heaters, WattSaver's its airflow requirements are modest (at about 200 cubic feet of air per minute).

In a very cold climate, with high heating loads, the unit's performance of the unit will not be as high as the manufacturers' claims since it draws heat from the space in which the water heater is located. Only during the milder periods, from spring to fall, will the unit perform at maximum efficiency.

ECR International Inc.
Tel.: 877-386-5475 Fax: 716-366-1209
www.ecrinternational.com

Three products on the top ten list are more suited for commercial applications. These include:

McDry Waterless Urinal

Non-water-using urinals were first introduced in 1992 by the Waterless Company of Del Mar, California in 2002. The latest such to be introduction introduced is the McDry urinal from the German company, Duravit. It has a sleek design and, unlike the other products on the market, does not have a trap cartridge that needs periodic replacement.

Like other non-water-using urinals, the McDry relies on a lighter-than-urine liquid that forms the trap to prevent odours. This liquid has to be replenished on a regular basis. The McDry requires flushing with water to remove deposits about once a month. Because this is a new product, there is very little performance information available.

Duravit USA, Inc.
888-387-2848
www.duravit.com

Decato Office Partition Systems

Preform Manufacturing, Inc.
www.preformpanels.com

Xlerator Electric Hand Dryer

Excel Dryer, Inc.
www.exceldryer.com

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e-mail: solplan@direct.ca

R-2000 Pick List Resources

Carpeting

Canadian Carpet Institute
647 Alesther Street
Ottawa, ON K1K 1H8
www.canadiancarpet.org
Tel: (819) 684-8444 fax: (819) 684-5444

Carpet and Rug Institute
P.O. Box 2084
Dalton, GA 30722-2048
www.carpet-rug.com
Publications: (800) 882-8846
Central Office: (706) 278-3176
Fax: (706) 278-88358
Tech. Dept.: (706) 428-2101

Air Filtration

National Air Filtration Association
1518 K St., N.W., Suite 503
Washington D.C. 20005
www.nafahq.org
Tel: (206) 628-5328 fax: (202) 638-4833

Paints and Varnishes

Environmental Choice
c/o TerraChoice
2781 Lancaster Road, Suite 400
Ottawa, ON K1B 1A7
www.environmentalchoice.com
Tel: (800) 478-0399 (613) 247-1900
Fax: (613) 247-2228

Flooring Adhesives

Environmental Choice
c/o TerraChoice
2781 Lancaster Road, Suite 400
Ottawa, ON K1B 1A7
www.environmentalchoice.com
Tel: (800) 478-0399 (613) 247-1900
Fax: (613) 247-2228

Kitchen Cabinets

Consult local cabinet makers.

Vinyl Flooring

Linosom Linoleum
1001 Yamaska Street East
Farnham, QC J2N 1J7
www.domco.com
Tel: (877) 436-6267 fax: (877) 296-7070

Armstrong Industries
Attn: Customer Response Center
P.O. Box 3001
Lancaster, PA 17604
www.armstrong.com
Customer Service Tel: (800) 233-3823

This resource list was prepared by Buchan, Lawton, Parent Ltd. for the Canadian Home Builders' Association. It is intended to be a living document, and will be updated from time to time as new information becomes available.

Forbo Linoleum Inc.
P.O. Box 667, Humbolt Ind. Park
Hazelton, PA 18201
www.forbo-resilients.com
Tel: (800) 842-7839 (570) 459-0771

FloorBiz, Inc.
P.O. Box 220105
Hollywood, FL 33022
www.floorbiz.com
Tel: 954-925-1629

Particle Board Underlayment

Trus Joist MacMillan
200 East Mallard Drive
Boise, Idaho 83706
www.tjm.com
Tel: (800).338-0515 (208).364-1200
Fax: (208).364-1300

Sierra Pine
www.sierrapine.com
West Coast Tel: (800) 676-3339
East Coast Tel: (800) 334-2250

UniBoard
3080, Le Carrefour Blvd Suite 400
Laval, QC H7T 2R5
www.uniboard.com
Quebec Tel: (800) 263-5240 fax: (450) 682-0550
Ontario Tel: (800) 263-5240 fax: (450) 682-0550
Tel: (905) 673-5743 fax: (905) 673-0175
Western Canada Tel: (604) 924-3904
fax: (604) 924-3905

Insulation

Environmental Choice
c/o TerraChoice
2781 Lancaster Road, Suite 400
Ottawa, ON K1B 1A7
www.environmentalchoice.com
Tel: (800) 478-0399 (613) 247-1900
Fax: (613) 247-2228

Owens Corning Canada Inc.
www.owenscorning.com
Tel: (800) 438-7465 (800) GET PINK

Johns Manville Canada Inc.
www.jm.com
Product and Sales Information
Tel: (800) 654-3103

Can-Cell Industries Inc.
14715-114 Avenue
Edmonton, AB T5M 2Y8
www.can-cell.com
Tel: (800) 661-5031 / (780) 447-1255
Fax: (780) 447-1034

Thermo-Cell Industries Ltd
www.thermocell.com
Tel: (800) 267-1433

Fibreboard
Bennett Fleet
2700, Bourgagne
Chambly QC J3L 4B6
www.bennett-fleet.com
Tel: (450) 658-1771 fax: (450) 658-5037

CanFibre
www.canfibre.com
Sales Tel: 827-3008 x-223
Tech Info Tel: 827-3008 x-224

Siding

Collins Wood
The Collins Companies Inc
Suite 500, 1618 SW First Avenue
Portland OR, 97201
www.collinswood.com
Tel: (800) 329-1219 / fax: (503) 417-1441

Drywall

WestRoc
www.westroc.com
Montreal Tel: (450) 632-5440
Toronto Tel: (905) 823-9881
Winnipeg Tel: (204) 786-3424
Calgary Tel: (403) 279-0916
Vancouver Tel: (604) 525-3461

James Hardy Gypsum
www.hardirock.com
Tel: (800) 426-3669 (800) 423-3127
(800) 753-1123

CGC
www.cgcinc.com
Tel: (800) 565-6607
Customer Service Tel: (800) 387-7920

Georgia Pacific
www.gp.com/gypsum
Technical Support
Tel: (800) 225-6119

Steel Studs

Canadian Sheet Steel Building Institute
CSSBI - ICTAB
652 Bishop St. N., Unit 2A
Cambridge, Ontario N3H 4V6
www.CSSBI.ca
Tel: (519) 650-1285 / fax: (519) 650-8081

Steel Framing Alliance
1726 M Street, NW Suite 601
Washington DC 20036-4523
www.nasfa.org
Tel: (202) 785-2022
Fax: (202) 785-3856

Energy Efficiency Resources

ENERGuide
http://energuide.nrcan.gc.ca
Tel: (613) 238-3222 Fax: (613) 995-4565

Gas fireplaces

In urban areas, gas fireplaces have become the fireplaces of choice. They are clean-burning, reducing smoke and dirt problems in homes and the city environment. Most sealed combustion direct-vent units are reasonably efficient, with a combustion efficiency in the 60-70% range. Although they are used as space heating appliances, especially in multi-family buildings, gas fireplaces are still not as efficient as heating devices.

B-vented units, which are not as widely used, are cheaper and still available. They have an efficiency in the 10-20% range. These units are meant to be decorative only.

A recent NRCan study has found that gas fireplaces are often used as supplementary heaters, even though they are meant to be decorative appliances.

The gas consumption of a fireplace is not just the gas consumed when the fireplace is on. The gas used by the pilot light can easily consume $100 worth of gas per year. In the summer, the heat the pilot light gives off contributes to overheating of the home. In well-insulated houses, and with a short heating season, this means a longer period of time that overheating could be a concern. That is one reason why R-2000 recommends that if gas fireplaces are used, they be units without a standing pilot light.

Suppliers acknowledge the fact that a standing pilot light contributes heat to the home, but focus on the benefit of the heat from the pilot that the homeowner receives. They also say that the prudent person turns the pilot on in the fall and off in the summer. However, we know how carefully people perform home maintenance. I suspect this is one of those tasks most people don't remember to do, assuming they know it is an option.

Most manufacturers offer both millivolt (piezo ignited) and electronic ignition units. Most units sold are equipped with a millivolt system ignition system, largely because these units cost less than electronic ones at initial purchase but do require a source of 120 volt electricity in order to operate, and that extra outlet is an extra cost.

A concern some users have about gas fireplace units without a standing pilot is their ability to be turned on during a power outage, as some people want to use these as a source of supplementary heat in the event of an electrical failure. It is possible to get heat from a millivolt fireplace when electrical power is interrupted.

Some suppliers also raise a performance issue. They indicate that the standing pilot light provides a safety feature because it helps burn off residual gas in the fireplace when this is turned off. As well, the standing flame keeps a constant draft in the unit by keeping warm air circulating through the vent, allowing for a quicker startup when the fireplace is turned on.

Many manufacturers have looked at battery backup for the igniters, and some products have this feature, but for some reason battery backup has never gained acceptance. ☼

Environmental Choice
c/o TerraChoice
2781 Lancaster Road, Suite 400
Ottawa, ON K1B 1A7
www.environmentalchoice.com
Tel: (800) 478-0399 (613) 247-1900
Fax: (613) 247-2228

US Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
www.epa.gov
Tel: (202) 260-2090

Green Building Materials
www.designinggreen.com

Oikos
Iris Communications, Inc.
P.O. Box 20
Lorane OR, 97451
www.oikos.com

Websites
www.greenbuilder.com
www.buildcore.com
www.oldhouseweb.net
www.buildinggreen.com

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000 www.R-2000.ca

Did You Know? . . . about Plastic Wood Composites

Composite lumber incorporates some of the characteristics of wood and plastic lumber. Recycled waste wood fibre is combined with recycled plastic resins to create a product that has some improved strength and aesthetic characteristics. Some products may be graded for structural use, mainly as deck structures. The wood component, however, will absorb water and fade over time.

Like plastic lumber, plastic/wood composites are not supposed to rot. What they don't tell you about plastic composite wood, however, is that the wood fibre is subject to biological attack. Mould and fungal deterioration can affect the structural properties unless the wood is treated in the manufacturing process.

Technical Research Committee News

Canadian Home Builders' Association

Reflective Paints

The way some paint products are marketed, buyers are left with the impression that the paint itself can insulate a house. In reality, there is no such thing as a reflective paint with an R-value of 20 or more. The fine print in the manufacturer's literature admits it, with references to equivalent to performance. Unfortunately, the large type gives a different impression.

In Solplan Review No. 104 (May 2002), we discussed the issues behind low-emissivity paints. The fact is that at best a low-e paint surface might increase the R-value by up to 1.4 - a far cry from the claims being made, which are based on test procedures that seem to have been invented to provide favourable results rather than standard ASTM (American Society for Testing and Materials) tests to which all other insulating products are tested. Most tests to which the radiant coatings are subjected do not measure the steady-state energy (heat) loss, but simply the temperatures in a test box at intervals of one minute, up to a maximum of five minutes. This is rather meaningless. Standard R-value testing is done over a much longer time period.

There is no data on how these paints perform at keeping heat *in* during a Canadian winter, although the reflective properties of low-emissivity or reflective paints may contribute to a slight improvement in comfort. The paints may have superior stretchability, bridging properties and adhesion to various substrates. They may be tough and resist abrasion during cleaning. They may be more or less permeable. However, giving such paints a high R-value is pushing it.

National Building Code Change Review

The proposed technical changes to the National Building Code, the National Fire Code of Canada and the National Plumbing Code of Canada are now available for comment.

The consultation is taking place until April 15, 2003 on the Internet. This consultation is coordinated by the Canadian Commission on Building and Fire Codes (CCBFC) and is being done with the provincial and territorial ministries responsible for building and plumbing regulation and fire prevention. The intent is to give code users a detailed look at the proposed technical changes, and to get feedback on each proposed change as to whether it should be approved, altered, or rejected.

British Columbia and Ontario are holding separate but parallel consultations on the technical changes. As provincial and national reviews are being done at the same time, every comment submitted through the national Web site or any of the provincial sites by April 15, 2003 will be reviewed by the relevant CCBFC standing committee. The technical changes that are approved by the CCBFC will then be published in the objective-based editions of the three codes in 2005.

Details can be accessed through the national Web site: *www.nationalcodes.ca.* There are links to provincial sites where a province specific consultation is being held.

This is the time to submit any concerns any user may have. While CHBA and other trade associations will make formal reviews and replies, there is still a possibility for significant changes to be missed.

Significant Proposed Changes to NBC Part 9 (Housing and Small Buildings)

Lateral Load Resistance (9.4.1. and 9.23.10.2.)

Lateral load resistance is often overlooked in the design of Part 9 buildings. However, larger houses with open floor plans and two-storey high rooms, which are becoming more common, and other types of buildings that fall under Part 9 may not have the inherent resistance of small simple residential structures. It is proposed to define configurations (combinations of braced walls and openings) where lateral load analysis would be required. In areas with high seismic loads such as coastal British Columbia or very high wind loads (e.g., Pincher Creek, Alberta; Harrington Harbour, Quebec; Cape Race, Newfoundland), lateral load analysis would be required regardless of building configuration.

Snow Loads (9.4.2.2.(1))

Failure of roofs because of snow loads is the most common structural failure in Canada, generally in larger buildings. The Standing Committee on Structural Design is proposing that the ground snow loads in Appendix C be changed from a 1-in-30-year return period to a 1-in-50-year return period which would result in an increase in snow loads of about 10%. Thus, roofs would have to be built to support these new snow loads. However, it is proposed to continue to include the 1-in-30 ground snow loads for Part 9 buildings, in Appendix C, and to add the 1-in-50-year loads for non-Part 9 buildings.

Stairs, Handrails and Guards - Section 9.8.

A task group produced a package of proposed changes on this subject, including a number of relaxations to certain requirements such as 45° winders and combined straight and curved stairs in a single flight of stairs.

Structural load criteria for guards are proposed. The loads are similar to those required in Part 4 but are less stringent for guards within dwelling units.

Spatial Separation

Subsection 9.10.14. on spatial separations of buildings has been repeatedly adjusted over the years until it has become one of the most complicated portions of Part 9. This section has been reorganized to make it easier to use, but the actual requirements have not been changed.

Insulated Concrete Form (ICF) Walls and Reinforced Masonry Foundations

(Subsections 9.15.1., 9.15.2., Articles 9.15.3.3.-9.15.3.7., 9.15.4.1., 9.15.4.4., 9.15.4.8., 9.20.17.)

Changes are proposed to provide detailed prescriptive requirements for engineered insulated concrete form walls for small houses with simple shapes. The changes would be incorporated into the requirements regarding foundations and aboveground walls.

Similarly, a set of changes is proposed that permits masonry foundation walls to be higher for a given thickness if the masonry incorporates reinforcing [9.15.2.3.(2), 9.15.4.1.].

Keeping the Rain Out

(9.25.4.2.(1) and (2), 9.27.1.-9.27.3., Appendix C)

An extensive set of changes is proposed for building envelope construction to protect the building against moisture damage.

Protection from precipitation is described in terms of two planes of protection, the first being the cladding and the second being the sheathing membrane and flashing, with or without a drained and vented air space. All residential buildings will be required to be built with two planes of protection (i.e. no face-sealed cladding). In wet regions, the two planes of protection would need to be separated by a capillary break. Normal vinyl or metal horizontal strip siding placed over sheathing paper would satisfy both of these requirements.

A set of simple prescriptive requirements addresses junctions between walls and roofs or decks. The proposed prescriptive requirements for flashing identify additional locations where flashing is needed to divert water to the exterior and specify minimum extensions, slope and end dams. The proposal requires flashing under windows and doors where the sills are not self-flashing, i.e., they do not extend over the cladding below and do not have a drip on the underside of the sill.

To identify high moisture-load regions, a new climate-defined moisture index will be added to the table of climatic data in Appendix C. This is a single number that reflects the amount of rainfall and the duration of drying periods at the location, and is based on research done as part of IRC's Moisture in Exterior Wall Systems (MEWS) project. Coastal areas will tend to have high moisture indices and prairie areas will tend to have low moisture indices.

Maximum Temperature of Water Supplied to Fixtures

Sentence 9.31.6.1.(2), Appendix A-9.31.6.1.(2)

It is proposed to regulate the maximum temperature of hot water supplied to every fixture in residential occupancies to 49°C (120°F) to reduce the number of burn and scald injuries.

Mechanical Ventilation - Section 9.32.

The proposed mechanical ventilation requirements in Section 9.32. include the following changes:

- The outdoor air duct to a forced-air heating system would be required to have both an adjustable damper and a mechanical damper. The airflow in the duct must be measured and the damper adjusted to ensure that excessive cold air does not flow over the furnace's heat exchanger.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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www.chba.ca

The mechanical damper must open only when the principal ventilation fan is in operation.

- If spillage-susceptible combustion equipment is present, all exhaust devices, other than the principal ventilation fan (e.g., bathroom and kitchen exhaust fans), would be required to be linked to make-up air fans of the same capacity. If no spillage-susceptible combustion equipment is present, an exhaust-only ventilation system can be used. The dwelling must have a forced-air heating system or a similar air-circulating system linked to the principal ventilation fan to ensure that the outdoor air drawn in through the building envelope (the only source of outdoor air in such a system) is circulated evenly throughout the dwelling.
- If the mechanical ventilation system could depressurize the dwelling, and the dwelling includes an attached garage, carbon monoxide detectors would be required.
- Designing the ventilation system in compliance with CAN/CSA-F326, "Residential Mechanical Ventilation Systems," continues to be an acceptable alternative.

Carbon Monoxide Detectors

(9.32.3.9)

CO detectors would be required in any dwelling that has any form of combustion equipment or an attached garage, regardless of the configuration of the ventilation system. A similar change is proposed to Part 6 of the NBC and thus would apply to all residential buildings, regardless of size. ☼

You Asked Us about Return Air Registers

I have a customer who is buying a five-year-old 1,700 sq. ft rancher on crawl space with a counter-flow natural gas forced air furnace. The return air register is on the ceiling in the hall. I understood that, to ensure an even heat distribution and comfort, the return air should be in the main hallway near the floor.

The City building department and the contractor who did the original installation tell me there is nothing wrong with placing the return in the ceiling, and running the return duct through the attic and down to the furnace. They tell me that the building code does not require the returns to be at the floor level. I have found several sources that mention the importance of upper level returns for air-conditioning but none that say anything about heat registers. Can you comment on this?

Comfort and performance are determined by a house's levels of insulation, airtightness, type of windows, and the proper sizing and distribution of the air in the house – not just by the location of the registers. The same applies to the type of furnace. All types of equipment, when designed and installed correctly, can provide comfortable indoor conditions.

A cold air return is typically placed near the floor, but that is not a code requirement. The most important thing is whether or not the heating system is doing what it is supposed to do; that is, to condition the house to create a comfortable environment by distributing the heat in a reasonably even way. To do that, the heating system must be sized appropriately, which is not just an issue of the size of the furnace, but also one of properly designed and installed ducts able to move the right quantities of air at appropriate temperatures as well as appropriate controls.

One of the reasons many people dislike forced warm air heating systems is because they have not been designed or installed properly and create noise, uneven heat distribution, and uncomfortable rooms.

Heat registers have been placed against the outside wall and under windows because houses have typically had low insulation levels and windows are poor insulators. This is done to offset the heat loss through the exterior envelope and to reduce the windows' cooling effect. Cold air returns have been placed on an interior wall to encourage convection currents through the house. In some cases, returns have also been placed high up on the wall or ceiling – especially in homes with high vaulted ceilings or with large passive solar gains. These high returns allow the recirculation of warm air through the house. The location of the heating registers and returns is not as critical in a well-built, well-insulated, airtight home with high performance windows.

Changing the location of the return air registers in the house you are looking at now would require checking the whole heating system to ensure its performance can be maintained and that the ducting changes can be made.

Return air is often a source of problems with forced air heating systems, where standard practice is to rely on construction cavities. Stud spaces and joist cavities are typically a major part of the return air duct system. In reality, these often do not perform adequately. They are impossible to seal, there is not enough air flow, and the air flow through the spaces is a source of much of the dust that homeowners complain about in forced air heating systems. The return air system should be fully ducted, but that is more expensive so is seldom done.

Homes with central heating and cooling should actually have a return for each room to ensure proper air circulation and to avoid pressure imbalances between rooms that can create major problems. The standard door undercut that is relied on to provide pressure relief too often is not adequate, so many rooms end up being pressurized.

You mention sources that suggest the placement of high returns for cooling systems. That is common practice in commercial buildings, largely because it is inexpensive. Cool air ideally should be introduced high and allowed to fall, thus creating a cooling effect. However, heating needs are dominant in our homes, and heat in forced warm air heating systems should be introduced lower down.

Because the heating ducts run through the crawl space, it would be more important to check whether or not the crawl space is insulated. The ducts in the crawl space should be sealed, as well as the return duct in the attic, which should be insulated.

Unsealed ducts in crawl spaces and in basements typically end up pressurising the crawl space, which means that dust and any other contaminants in a poorly insulated crawl space will be forced up into the main portion of the house. This is one reason for the carpet stains so often seen in houses with forced warm air heating. ☼

Renovation Improves Air Quality and Increases Energy Efficiency

Winner of Energy Efficiency Award from the Office of Energy Efficiency

Home renovations can deal with many issues, not just structural, maintenance and energy, but also health. The renovation of a 1957 Vancouver home was started because of the owner's need for a healthy indoor environment. The owner suffered from a respiratory disability caused by work-related exposure to noxious chemicals.

The initial inspection of the home identified the home was built in accordance with conventional practice at the time, but had problems, including excessive mould problems and a lack of adequate ventilation. The renovations were done to improve the indoor air quality and add energy-efficient features to save on heating costs. The R-2000 Standard technical requirements were used as a guide to the improvements made, since the owner wanted to be certain the outcome would address his health concerns.

Exterior walls were stripped to the framing to bring them up to current standard. Insulation levels were increased to from R-8 to R-40 in the ceiling; walls R-8 to R-20 (2x4 walls with 1 ½" Styrofoam); basement walls were waterproofed and insulated (R-12); original aluminum single glazed windows were replaced with vinyl framed high performance windows. Two masonry wood burning fireplaces (one in the basement, one on the main floor - on the exterior wall) were removed.

Because health was the driving force for the work, the mechanical system was changed to provide a safe, effective ventilation system in the house. A combination mechanical system for domestic hot water, space heating, and a continuous fully distributed ventilation system was used. A heat recovery ventilator provides the fresh air.

To ensure air quality over the long term, low emissions paints and sealers and finishes were used throughout. Cabinets are made of low emissions MDF board and completely sealed. Existing carpeting was removed and all floors were refinished with hardwood, ceramic tile or laminate flooring.

The equivalent leakage of the original 2,340 sq.ft house was 358 sq.in (2,309 cm^2 or 11 ACH @ 50 Pa.). The leakage area of the renovated and enlarged house, with a floor area of 2,900 sq.ft. is 104 sq.in. (670.9 cm^2 or 2.9 ACH). The air sealing strategy followed was airtight drywall.

Reducing the air leakage by 70% has meant a substantial improvement in the house performance, but it still falls short of the stringent R-2000 standard, even though the contractor and air sealing crew are experienced. This project underscores the challenges of air sealing existing structures. In retrospect, it appears that if an exterior air barrier approach had been considered, the house may have met the R-2000 Standard.

The *EnerGuide for Houses* rating after renovations were completed is 80, which is equivalent to that of a new R-2000 house (before the start of work was 65). What is more important, the homeowner appreciates the healthier, cleaner air. After six months in the home, he has noted a significant improvement in his health renovation.

The project is the recipient of an Energy Efficiency Award from the NRCan's Office of Energy Efficiency. The contractor was Harald Koehn Construction, Richard Kadulski the project architect. ☼

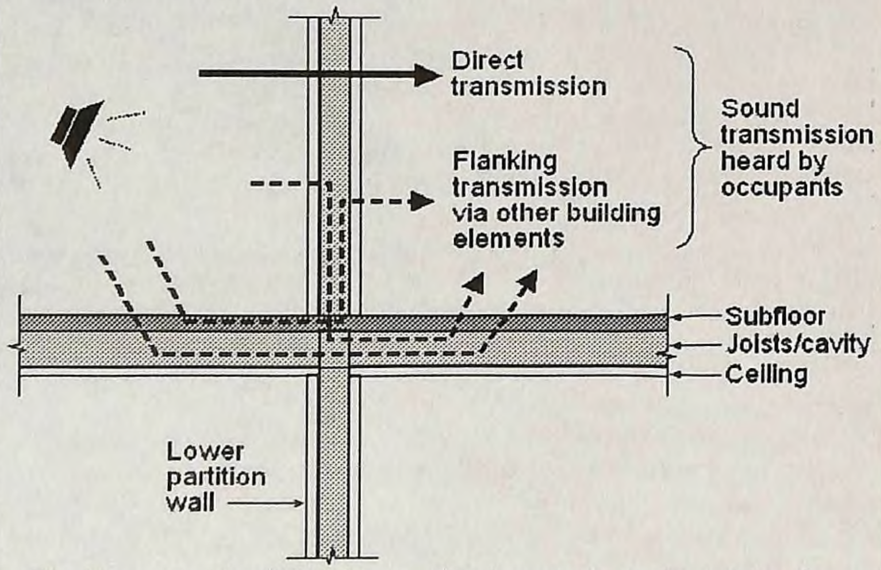
Wall/floor details affect sound insulation in multi-family dwellings

By Trevor Nightingale

Every day builders are faced with the problem of building housing that meets sound insulation targets cost effectively. Recent IRC acoustics research makes it abundantly clear that without an understanding of how the various building elements interact it is impossible to achieve adequate sound insulation.

Wood-framed multi-family dwellings built in regions where there are high wind loads or potentially severe seismic conditions pose a particular problem, as they often require continuous building elements to ensure that structural integrity among units is maintained. While continuous floor elements help the building withstand wind or seismic loads, they can also transmit sound energy between adjacent dwellings in the form of structure-borne vibration. This type of vibration passing via the floor and around the separating wall is known as flanking transmission, which can lead to reduced sound insulation between dwellings or rooms. It is the combined acoustic performance of the wall/floor system —not that of the separating assembly itself—that determines the sound insulation between the two rooms. (See figure).

Flanking transmission is sound transmission between two rooms by paths other than the direct path through the separating wall or floor assembly.



Flanking occurs in all buildings and its importance in determining the sound insulation perceived by occupants is a function of the construction details of the wall/floor system, not just those of the wall.

The research project

To address the problem of flanking, IRC researchers undertook a three-year consortium project to examine the effect of using continuous structural elements that pass under a partition wall between two horizontally separated multi-family dwellings—for example, subfloor sheathing and joists. In addition to varying structural continuity, researchers also systematically investigated the effect of changing joist type, blocking details at the wall/floor junction and type of partition wall.

Project results

The research clearly demonstrated that except in cases where required to provide adequate structural performance, building elements (such as OSB, gypsum board and joists) should not be continuous across or under a partition because they introduce significant flanking paths.

When the OSB subfloor was continuous, the sound insulation was limited to an apparent STC (i.e., the STC as experienced by the occupant) as low as 44, despite the fact the rooms were separated by an STC 52 wall. When both the joists and subfloor were continuous, the degree of structural coupling increased and flanking was even more severe, achieving an apparent STC as low as 38. Because the dominant transmission path is from the floor in one room to the floor in the adjacent room, increasing the sound insulation of the separating wall assembly would be largely ineffective.

Using a continuous subfloor, researchers altered various construction details to assess their effectiveness in controlling flanking. Although structure-borne vibration must flow through the wall/floor junction connecting the upper two rooms (as shown in the figure), blocking details proved not to be an important factor, nor did joist type—solid wood and wood-I joists performed similarly. Changing the partition wall from single- to double-stud construction produced a minor improvement, primarily because the attenuation of structure-borne vibration at the wall/floor junction increased. However, the better sound insulation of the double-stud wall was short-circuited by the flanking transmission.

Flanking between rooms separated vertically by a floor/ceiling assembly was also investigated. The dominant path is typically from the subfloor above to the wall in the room below. However, this vertical flanking is typically less severe than the flanking that occurs between horizontally separated rooms because vertically separated rooms are not usually coupled by continuous building elements. Flanking that involves wall and ceiling surfaces can be significantly suppressed by mounting the gypsum board on resilient channels, and adding additional layers.

How to control flanking

Because the dominant flanking paths between both horizontally and vertically separated rooms are typically via the subfloor, researchers also investigated the effectiveness of various floor toppings. They learned that a correctly designed and applied floor topping can effectively control the severe flanking paths created when continuous elements are introduced, and can also improve the sound insulation of the floor/ceiling assembly. It should be noted, however, that the optimal physical properties of the topping system for airborne sound are different than those for impact sound. Although attenuation for both types of sound is improved by adding a topping that increases the mass of the subfloor, the hardness of the surface exposed to impacts should not be increased. Toppings such as (gypsum) concrete should be used in conjunction with pliable materials placed either on the surface (such as carpet or vinyl) or between the topping and the subfloor (resilient interlayer).

☼

Dr. Trevor Nightingale is a senior research officer at the National Research Council's Institute for Research in Construction. He can be reached by e-mail at trevor.nightingale@nrc.ca. At http://www.nrc.ca/irc/publications.html, you can find the detailed project report, IRC Research Report RR-103. (This article appeared first in the December 2002 edition of Construction Innovation.)

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Spring Training Camp

Shake off the cobwebs after winter hibernation

April 6, 7, 8, 2003

Spring Training Camp is the creation of Tex McLeod, an Ontario housing consultant and R-2000 trainer. The idea for a building-science spring camp has been borrowed and adapted from Joe Lstiburek's successful Summer Camp held each August at his home near Boston. Joe and his wife Betsy have created one of the most exciting annual events for building industry folks. It informally brings together North America's leading building scientists and educators and liberally mixes them with America's most dynamic builders. That is exactly what we are setting out to do in a Canadian context. A sort of "Davos Forum" for builders.

To kick off this year's inaugural event, Joe Lstiburek will be our featured speaker. You'll have the full first day to listen to and talk with Joe. Joining Joe on Day Two will be John Straub from the University of Waterloo and Don Fugler from CMHC. Both are interesting guys doing important research work and able to communicate it really well – a powerful combination. The real magic comes when this good energy is overlaid with smart builders ready to talk, explore and share ideas.

Where? Hockley Valley Resort near Orangeville, Ontario. The facility is the former Ontario Hydro Training Center, equal parts ski lodge and university dorm in a really beautiful setting, close to Toronto. We have put together an all-inclusive package that includes an opening reception on Sunday night, the seminars Monday and Tuesday, accommodation and all the hospitality and great meals for $550 (plus GST).

Spring training camp is designed to break even. If we make money we'll give it away – perhaps as a scholarship. If we lose money, we might have to pass the hat – depends how much we lose…sort of like homebuilding . .

Send in your application today!

Yes, you have to be invited – just like real spring training camp. We've only got space for 60 and we need to ensure a good mix – the right amount of salt & pepper, scotch and chocolate. Priority will be given to those ready to take things up a notch – "same old" just isn't good enough. It isn't now and it definitely won't be in the future.

Let us know something about yourself and why you want to attend. Bribery or other payments above (or under) the table will not be considered. Send your application to OHBA, attn: Susan Woolsey, 20 Upjohn Rd., Toronto, ON M3B 2V9; fax 416-443-9982; e-mail: *swoolsey@ohba.ca*

Spring Training Camp is organized by Enerquality Corporation and the Mcleod Associates in association with Ontario Home Builders Association, Solplan Review, and the University of Waterloo.

Energy Answers

Rob Dumont

What is an Integrated Design Process (IDP)?

Here is a definition that hopefully captures the essence of IDP: "An IDP is a design process in which all major components of the building are considered and designed as a totality. Components are not designed in isolation of their effects on other components and systems."

Two centuries ago, the building process for larger buildings was very simple. An owner would contact an architect/designer who would design almost everything for the building, then a builder would construct the building. Buildings often had no mechanical systems other than a wood or coal stove; electrical systems such as lighting, telecoms, etc. were nonexistent; interior decorating was done by the architect, as was the landscaping. An architect could do the entire design process himself, and there really was no problem of communication among the design staff. If you think about this, many of the great buildings of the world were designed and built this way. I recently visited the Pantheon in Rome, finished in the second century AD. It, like most of the memorable buildings of Rome, was likely built with a single designer.

In block diagram form, it worked like this.

Owner ☞ Architect/Designer ☞ Builder ☞ Site Crew

Figure 1. Building Construction Circa 200 Years Ago

Fast forward to the present era. Because of the complexity of building systems, the flow now often goes something like this:

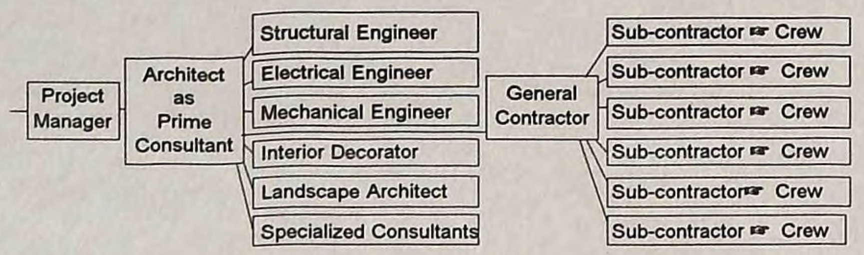

Figure 2. Building Construction in Current Times

Other specialists, such as computer modelers, control systems specialists, code review consultants, cost accountants, elevator specialists, kitchen specialists, internal traffic specialists, etc. can also be involved in the process, further adding to the complications.

As you can see by comparing the block diagrams, the task of building a great building these days is much more complicated. No one designer is an expert in all phases of building design; thus, communication among all the designers is now a crucial element in good design.

The basic idea of the integrated design process is to use a single design desk approach in which all the design team members are involved from the beginning of the process. The following diagram shows schematically how this would work.

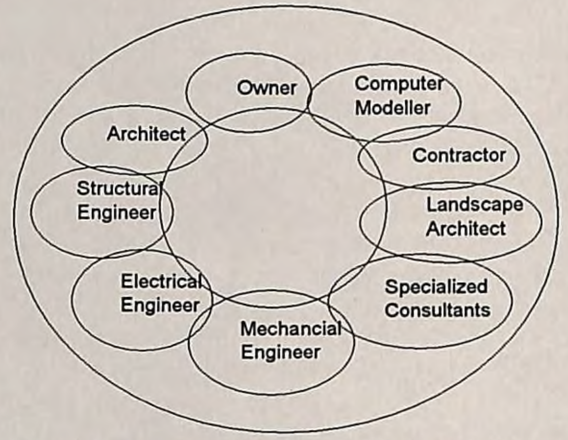

Figure 3. Integrated or Concurrent Design Process

Figure 3 is an idealized diagram. Someone has to co-ordinate the inputs from the various team members and ensure that the integrated design process is on track with real deliverables. Sometimes an external project facilitator is hired for the process, and sometimes one of the design team members can serve as the facilitator.

For most large buildings, the contractor is not usually involved at the design stage, as it is not known who the contractor will be until after the building is tendered. The accumulated knowledge of contractors, however, should be tapped for the integrated design process, even if the contractor is not directly present at the table.

One might question, for instance, whether all of this communication and integration is necessary. For instance, what information would the electrical engineer and the landscape architect have to share? However, there are several items of interest. The electric lighting scheme for a building is often designed by the electrical engineer, and the exterior planting schedule (trees, vines, site grading, etc.) can affect the daylighting scheme, which will in turn affect the control system for the lighting.

A great advantage of the integrated design process is that capital cost savings in certain areas (heating and cooling, for example) can be achieved by improving the building orientation and the building envelope. Lower energy bills and life-cycle costs can result. The American architect Frank Lloyd Wright once wrote that "You should never put anything in a building that serves only one function." For building elements to "multi-task," a high degree of integration is needed, and generally this cannot be achieved with "dis-integrated" designs resulting from poor communication among the design staff.

Getting the Integrated Design Process Started.

1. Define the Design Goals

Different owners will have different goals. It is very important, from the start of the IDP, to have the goals well defined. For some building projects the goal may be very simple, such as providing the owner, who wishes to sell the building on completion, an acceptable rate of return in the marketplace. Another owner, such as a housing cooperative, may have a larger number of goals such as a very durable building with low energy costs, high local material content, high local labour content, a highly attractive building, excellent indoor air quality, etc. Having the goals for the building well articulated is a major first step in the IDP process. A written statement of the design goals is very useful.

2. Be quantitative with the goals where quantitative criteria are appropriate. Some quantitative criteria might include the following:

Energy Related Goals:

- The building will meet the Commercial Building Incentives Program energy target (25% less than the Model National Energy Code for Buildings
- Lighting levels in the offices will not exceed 400 lux; lighting power densities will not exceed seven watts/sq.metre
- All hallway lighting will be controlled during unoccupied hours using occupancy sensors
- All ventilation air must have heat recovery equipment installed with a minimum sensible heat recovery effectiveness of 0.6
- Heating and cooling energy should preferentially be distributed using liquid flows rather than air flows

Indoor Air Quality Goals:

- All interior carpeting must meet the Carpet and Rug Institute standard for off gassing of volatile organic compounds and formaldehyde
- The separation distance between air intakes and air exhausts and chimneys for the building must meet the ASHRAE recommended values
- All paints must be low emission type
- All occupied spaces must have a ventilation rate of eight L/s per person when occupied, or match the ventilation rates as specified in the ASHRAE Standard 62

Water Conservation Goals

- All clothes-washing and dishwashing machines must meet the Energy Star rating standard where appropriate
- All shower heads must have a flow rate not to exceed 10 litres/minute at a pressure difference of 551 kilopascals (80 psig)
- All toilets must have a water consumption per flush not to exceed 6 litres
- Exterior landscaping will be designed to minimize water use. Native vegetation with low water requirement is to be used, and lawn areas should be minimized.

Natural Lighting Goals

- The building orientation and window placement should favour the use of natural lighting and not artificial lighting during the day lit hours. Exterior shading, light shelves and light-coloured surfaces are recommended, as well as an interface with the room lighting to dim or turn off artificial lighting when daylight is available.

Recycling and Solid Waste Management Goals

Transportation Goals

All of the major design team members should be present while the goals for the building are formed (assuming the owner does not provide these in advance). In turn, the design team members should ensure that all of their associates involved with the design are also informed. It does little good if the owner wishes to have a high efficiency office lighting system (less than 0.75 watts/square foot) and the draftsperson selects a system that uses two watts/square foot because she was unaware of the overall goals of the project.

3. Proceed with the Integrated Design

The following elements in an integrated design should all be formally addressed with all members of the design team present:

1. Owner's expectations, including minimum requirements regarding energy performance.
2. Building function, and massing of the building
3. Site development – use of natural attributes of the site (solar orientation [passive and active], views, access to daylight, levels of daylighting required, wind patterns, snow patterns, opportunities for use of site-based resources, transportation, landscaping)
4. Regulatory constraints, code and zoning requirements
5. Building structure type – wood, steel, concrete, etc.

6. Building thermal and moisture protection
7. Interior finishes
8. Heating, ventilating, air conditioning, water supply and removal
9. Electricity supply and demand, equipment, artificial lighting, motor selection, controls, etc.
10. Landscaping
11. Quality control

Each of these 11 categories will have either major or minor effects on each of the design team members. Time should be spent at the start of the project reviewing each of these categories with all design team members present, focusing in on design concepts that can be carried forward. Ideally, a consensus on these issues can be reached by the design team members. In some cases, additional information will be needed to help make decisions. Each design team member should come to this meeting prepared with one or more design approaches in his or her specialty area. Visual presentations illustrating the concepts are much preferred to oral descriptions, particularly for technologies that may be new to the other design team members. Every design team member has to "sell" his or her ideas to other members to get a consensus and to show how their idea "fits" with the design/performance goals.

This integrated approach should continue from the conceptual stage through the detailed design stage and onto the construction and commissioning stages. In the C-2000 process for advanced Canadian commercial buildings, a designated Integrated Design Facilitator has been used to assist with the integrated design approach.

What are some of the disadvantages of integrated design?

1. It is a change from past methods, and who really likes change?
2. Most professional people are trained in an environment where they are most comfortable working with their own kind: architects with architects, engineers with engineers, etc. Integrated designs must be interdisciplinary, but our universities, colleges and trade schools almost exclusively focus on single discipline learning.
3. More decisions have to be justified and defended.
4. Egos are more exposed, power struggles can occur.
5. Designs can take longer until people around the table are more familiar and comfortable with the process.
6. IDP does not work well (or at all) in a fee environment where one's compensation is rigidly based on a percentage of the capital cost of the building. In a percentage-based fee environment, for instance, the mechanical engineer's fee would be a certain percentage of the cost of the mechanical engineering contract for the building. There is no financial incentive for the mechanical engineer to reduce the cooling or heating plant size when his or her fee is based on the size of the mechanical contract. A leaky, poorly insulated envelope with poor windows demands larger heating and cooling equipment, which will generate a higher design fee for the mechanical consultant. It is best to negotiate fee sharing among all participants up front (perhaps using traditional percentages) and get that out of the way.
7. A relatively strong but fair leader or facilitator is needed to keep the process on track. Extra effort is needed to involve all design members in a meaningful way.
8. An environment must exist where all design team members feel free to offer creative suggestions and challenge other members.

What are some advantages of integrated design?

1. Decisions are made in a group environment. There are fewer surprises and fewer guesses involved.
2. An opportunity exists at the start of the project to clearly communicate to the entire design team the expectations of the client and the energy performance goals of the project.
3. Equipment can be more appropriately sized, as the intended use of the building and its spaces are more widely known.
4. Synergies can result; components can serve more than one function and save costs.
5. All expertise is present at one table, and a stimulating environment for problem solving is possible.
6. Conflicts can be dealt with at the design table and not on the job site. Tender document quality and coordination between documents can be improved.
7. Smaller, more appropriately sized heating, cooling, and ventilating equipment can result, with substantial savings.
8. The owner can achieve a more cost-effective and satisfying building, with better comfort levels and lower energy costs.

Most large buildings are not designed using an Integrated Design Process. The Integrated Design Process approach, by breaking down the "silos" of individual designers, can help make large building projects less dis-integrated, and more successful.

In the automotive and aircraft design field, integrated design is now relatively common. There even exists a Society of Concurrent Product Development (www.sce.org) whose mission is to "develop and promote the application of Concurrent Engineering and Integrated Product Development in companies and organizations worldwide."

In Canada the C-2000 program, developed by Natural Resources Canada, has been a key catalyst in encouraging the Integrated Design Process for buildings. Nils Larsson of NRCan has been an eloquent and tireless advocate. More information on the C-2000 Integrated Design Process is available at

www.buildingsgroup.nrcan.gc.ca:80/projects/idp_e.html ☼

Coming Events

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Tel: 905-954-0730
Fax: 905-954-0732

February 27-28, 2003
9th Conference on Building Science & Technology
Vancouver, BC
tel: 604-294-0043
Fax: 604-299-4517
www.bcbec.com

March 5-7, 2002
World Sustainable Energy Day 2003 Conference and Trade Show
Wels, Austria
Tel: 43-732-7720-14380
Fax: 43-732-7720-14383
www.esv.or.at

March 31 - April 5, 2003
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